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# Memo

*DATE:* *May 19, 2002*

*TO:* RHIC E-Coolers

*FROM:* *Ady Hershcovitch*

*SUBJECT:* **Minutes of the May 17, 2002 Meeting**

Present: Ilan Ben-Zvi, Al Garren (Dejan's guest from LBL), Ady Hershcovitch, Jorg Kewisch, Derek Lowenstein, William Mackay, Christoph Montag, Stephen Peggs, Thomas Roser, Triveni Srinivasan-Rao, Dejan Trbojevic, Dong Wang, Jie Wei, Vitaly Yakimenko, Qiang Zhao.

Topics discussed: Simulation & Calculations.

**Simulation & Calculations**: Dong reported on the status of simulations and calculations performed with SIMCOOL, written by Vasily Parkhomchuk for the purpose of the "Electron Cooling for RHIC" design report. The code's purpose is, in the long run, to set parameters that optimize electron beam cooling until BETACOOL becomes available. In the latest calculations, the SIMCOOL code is used in an attempt to compare it with Parkhomchuk's design of "Electron Cooling for RHIC." Ilan pointed out that Parkhomchuk, who was consulted during this latest set of calculations, was very helpful.

SIMCOOL is a short code that is capable of treating ion and electron arbitrary distributions. In the report, Parkhomchuk used empirical formulas that were solved with MATHCAD. With 5 nC and 10 nC in the electron beam and a magnetic field error of $1.3 \times 10^{-5}$, SIMCOOL yielded a cooling rate that is slower than Parkhomchuk's values in the design report. The design report used 10 nC. SIMCOOL also yielded a higher emitttance, which is most likely due to the development of tails. These discrepancies with the report's results are probably due to the fact that SIMCOOL exaggerates intrabeam scattering in the tails. Basically, SIMCOOL is good for beams with square profiles. Additional results indicate that recombination is not a severe problem.

Next, Dong showed the scaling of emittance and cooling rates with changes in solenoid magnetic field error and electron beam current. By lowering the magnetic field errors, not much is gained in terms of the emittance. However, the cooling time improves substantially with increase in beam current or with lowering of the solenoid magnetic field errors. Cooling time decreases roughly linearly with increase in electron beam current. With reduction in solenoid field error, cooling time seems to decrease more dramatically (square or cubic relation). But, Ilan pointed out that by increasing the beam current by a factor of 2 or reducing the field error by the same factor yields the same results.

Regarding the validity of plasma physics formulas in our case, where we have truncated Maxwellians and a Debye length > beam diameter, Waldo commented that Parkhomchuk's formulas are empirical. These formulas, which contain empirical "fudge" factors, have proven to work well for existing electron beam coolers. Although a RHIC E-cooler will operate at a much higher energy, the cooling mechanism is the same. Therefore, Parkhomchuk's formulas should be applicable as well.

Finally, the issue of how accurate can the magnetic field be made or measured was brought up. According to claims from Novosibirsk, field errors of $10^{-6}$ are achievable. Ady mentioned that the SuperEBIS solenoid field errors could not be detected in measurements made by members of Bill Sampson's group. Suggestions were made to use this magnet to develop accurate diagnostics for magnetic field error measurements. Post meeting info: uncertainty in magnet location (with respect to its cryostat) and vibrations in the probe mechanical motion limited measurement accuracy. Furthermore, solenoid specs called for an accuracy of only $1x10^{-4}$.